Physical Science ---- Geology, Soils, Geomorphology, Hydrology

Key Question: What are the major physical features in the watershed?

The landforms present in this analysis area may be broadly characterized as either:

planar slopes that make up interfluves between streams,

ridges,

terraces adjacent to stream channels,

landslide deposits

stream channels.

Planar slopes by far make up the largest area within the watershed. The remaining features, and especially stream terraces, while not areally extensive, often are the focal point for people. The majority of the smaller stream terraces modelled on the low slopes map are isolated from the stream channel and are relict features from historic channel elevations. Other low slopes are deposits from ancient landslides, the alluvium that underlies Sauers Flat, Kerby and Cave Junction, and ridges.

Ramp and Peterson, 1979 discuss the gold placer deposits located in the analysis area. The gold was mined beginning in the 1850's from the terraces along the Illinois River and Josephine Creek. The terraces within this reach of the Illinois were extensively mined during the latter part of the 19th century and early part of the 20th century (see mining report). It is estimated that nearly 100 percent of the terraces in this analysis area have been mined or are in use as home/ranch sites. There are, however, fragments of terraces that have not been mined in the past. There are also terraces that are no longer being mined today.

There are terraces in the Wild section of the Illinois that have not been mined, several of these have been used for both pre-historic and historic homesites. The historic condition of the terraces included in the Middle Illinois WA analysis area is likely to mimic the condition of the terraces in the wild section. In general the gravelly soils support relatively few large trees and are largely covered in grasses and forbs. They are not likely to play a large role in terms of water storage and base flow water supply due to the well drained soils and limited areal extent. The unmined surfaces do supply less fine sediment than do the disturbed terraces.

The stream channels in the analysis area may be broadly segregated into 3 types; high gradient tributary streams, the canyon portion of the Illinois River past Kerby, and the alluvial portion of the river from the Forks State Park through Sauer's Flat. Due to limited road building and access and limited timber harvest, the steep tributaries in the Forest Service portion of the watershed are likely relatively unchanged in regards channel form and process relative to pre-European conditions. The high gradient tributaries in the Kerby watershed have likely been more impacted by human activity and are more likely to experience changes in channel form, higher rates of bed and bank erosion and changes in sediment transport. The canyon portion of the river is unlikely to have changed much relative to pre-European times because the bedrock bed and banks make this reach highly resistant to impacts.

Channel form in the alluvial portion of the river is very likely to have changed. The river in this reach is characterized by long, straight reaches dominated by riffle habitat. This land is used for agricultural purposes and the channel appears to be confined in order to maximize land for growing. Straightened channels do not have as many deep pools as do channels that migrate naturally. Straightened channels also tend to be steeper gradient, and there are fewer places where off-channel habitats can provide refuge during high flows.

The watersheds covered by the Middle Illinois WA are underlain by a diverse assemblage of rock units (see geology map). The following chart gives the acres and percent of the WA area covered by each major rock unit. The geology is broadly characterized by four 'bands' of northeast-trending rock units. The data included in the table below summarizes acres as mapped at the 1:500,000 scale by Oregon Department of Minerals and Geology. Higher resolution maps are available, but not electronically. The majority of the rock units are Jurassic in age, with the notable exception of alluvium along valley floors and terraces, which are Quaternary in age. This area is nested within the larger Klamath Mountains Province, excellent coverage of regional geology is available in "Geology of Oregon" and numerous other texts.

Rock Unit	Ultramafic-Serpentine	Rogue and Galice Formation Metamorphosed Sediments and Volcanics and melange	Alluvium of Quaternary Age Qal), Terrace Deposits (Qtg)	Landslide Deposits large enough to be mapped	Gabbroic and Diabasic Rocks of Jurassic Age	Applegate Metamorphosed Sediments and Volcanics	Briggs Creek Amphbiolite
Acres	40716	7557, 916	3019, 2350	320	2235	15887	31
Percent of Area	50	10	7	<1	3	19	<.1

Contact zones between rock units are often characterized by extensively sheared and faulted areas that are especially susceptible to erosion and the development of locally deeper soil profiles. The soils in this area reflect the bedrock geology and the influence of climate and time of development (see soils map.). Soil depths range from 20 inches to 60 inches on average. Soils developed on ultramafic serpentine bedrock support less extensive vegetation than other soils (see vegetation map).

Nickel-rich lateritic soils have developed on the southeast flanks of Eight-dollar Mountain (Ramp and Peterson, 1979). An extensive mineralogic and soil profile description of these soils is available in Hotz, 1964). There are also laterites located along the Woodcock Mountain Ridge and other locations in Josephine Creek (Ramp, 1985).

Key Question: What are the dominant erosion processes in the watershed? Where have they or where are they likely to occur?

The erosion processes are linked to the geology. The ultramafics are characterized by landsliding over the long term and sheet, rill and gully erosion in the short term (West Fork Illinois Watershed Analysis, physical science section). The Applegate metasediments and metavolcanics are characterized by landsliding and a lesser degree of surface wash. High rock fragment content makes the soils derived from the metasediments more resistant to erosion than the metavolcanics. The Quaternary alluvium is very stable as it occupies largely low gradient slopes. The Galice metasediments are also very stable, steep slopes are subject to rockfall and shallow debris slides.

The erosion processes are also linked to management practices. Roadbuilding has a multitude of effects including interception of groundwater, routing of flow, compaction, sediment delivery and mass failures. The rock types in this watershed that are most prone to erosion due to road building and use are the ultramafics and grantics. Very few roads access the relatively small amount of granitic rock in this watershed.

There are a number of roads that access the river. These roads are low standard, often gullied and generally poorly drained. Site-specific drainage design and/or closure is necessary. These roads are identified and prioritized in the recommendations table portion of this document.

The ultramafic rocks have a number of low standard roads that traverse this rocktype. The roads were built to access chrome and other minerals in the early part of this century. These roads are often gullied, disruption of the natural drainage network is common. Most of these roads are no longer drivable and erosion has stabilized. Notable exceptions to this are places on the river road 4103, segments of the onion camp road 4201, rancherie road 4103-087 and the mining roads near Day's Gulch 4201-881 & 820. These roads vary in the extent of erosion, all are characterized by eroding cutbanks. The main 4103 and 4201 are surfaced, so wash of the road bed itself is limited, the remaining roads are often muddy during rain storms, especially when there is traffic. The 4103-087 is closed during the wet season.

Other management can result in increased rates of erosion. Specific areas in this watershed include effects of recreation, timber harvest, historic and current mining, and land development for agricultural, residential and industrial uses. Many of these land uses result in disturbance of the vegetation and soil such that fine sediment is delivered to streams. Observations made during storms reveal that sediment is delivered primarily due to roads associated with the activities listed above. Vegetation removal likely is the second leading cause of sediment delivery.

Key Question: What are the dominant hydrological features in the watershed?

The hydrology of the Illinois River itself is characterized by a very seasonal distribution of flow (see graphs of Mean Daily Flows and Monthly Exceedance Probabilities) The river peaks in response to rain events, the largest historic peaks occur when that rain melts a snowpack.

Summer low flows are the most critical and limiting resource concern, both from the perspective of aquatic biota and in regards water needs for human uses (see graph of annual low flows on the Illinois

River near Kerby). Summer low flows are a result of many factors, the dominant being the seasonal distribution of precipitation. In addition to low summer precipitation, extensive water use occurs throughout the basin.

The majority of the consumptive water use on the Illinois system occurs upstream of the Forest Boundary, there are uses downstream of that point, however. A cooperative effort with the Natural Resources Conservation Service is nearly complete (due July, 1999) . That study will present detailed information with regard to water availability and use, this report will be updated with the results of that study once the NRCS work is complete. Any consumptive use of water during low flow periods is likely to exacerbate the existing low flow concerns on the Illinois system.

The right to use water in the state of Oregon is governed by several statutes. "In general, Oregon's water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. Surface or ground waters may be legally diverted for use only if issued for a beneficial purpose without waste. A water right is attached to the land where it was established, as long as the water is used. If the land is sold, the water right goes with the land to the new owner. Once established, a water right must be used at least once every five years as provided in the water right." (Entire paragraph excerpted from: *Water Rights in Oregon*, Oregon Water Resources Department).

Other land uses can result in effects to low and high flows. Specific areas of concern in this watershed include effects of timber harvest and land development for agricultural, residential and industrial uses.

The city of Cave Junction also has a permit to discharge treated waste water into the Illinois River immediately downstream of the city, this permit is administered by the State of Oregon.

The Illinois River is listed as 303(d) listed for violating state standards with regard to water temperatures. Summer water temperatures have been monitored for a number of years at the Kerby gage and in Canyon Creek. In 1998 data were collected throughout Josephine Creek (see temperature summary table). The data indicate that the river and Josephine Creek commonly exceed State water quality standards for temperature for many days during the summer months. A water quality management plan will be prepared for these areas as required by State Law. The plan is due by 2004. A few of the tributaries feeding Josephine Creek and a few that enter the river are much cooler. These sites likely provide refugia for salmonids and other fish that prefer cool water.

Key Question: How do the physical features compare with others in the Illinois/Rogue system? What is similar? What is unique?

The physical features in this watershed are mostly the same as those found elsewhere in the Rogue. There are some notable and unique features, especially the terraces dominate Josephine Creek and the River near Deer Creek, the fault-bounded alluvial flats that underlie 'greater Cave Junction and Kerby', and the beautiful river canyon. The Falls are also very unique. The large expanses of sparsely vegetated serpentine are unique to this area.

Key Question: What are the general sediment transport and deposition processes?

The Illinois is characterized by turbid winter flows in response to winter rains. Not all rains result in the transport of sediment, but the discharge at which transport commonly begins is not precisely known. Transport of bedload sediment also occurs once a critical discharge is reached, this value is not precisely known. The canyon portion of the watershed is very resistant to both lateral and vertical changes in bed position, but the depth of pools may be changing over time. The portion of the river most likely to show these changes would be the section that runs from the Forks down to the beginning of the canyon near Kerby.

Many valley residents have expressed the opinion that sediment loads resulting from timber and other management in the upper watershed has increased the supply and transport of material in the Illinois relative to background conditions. The processes are in place for that supposition to be true; e.g. created openings that are correlated with landslide activity, sediment derived from roads and channel changes resulting from those events and mining history. There are no bedload transport data available to test the hypothesis, however. Changes in channel form are also being considered as part of the pending NRCS study and will be included in this report as available.